 Apple Lisa Computer
Technical Information

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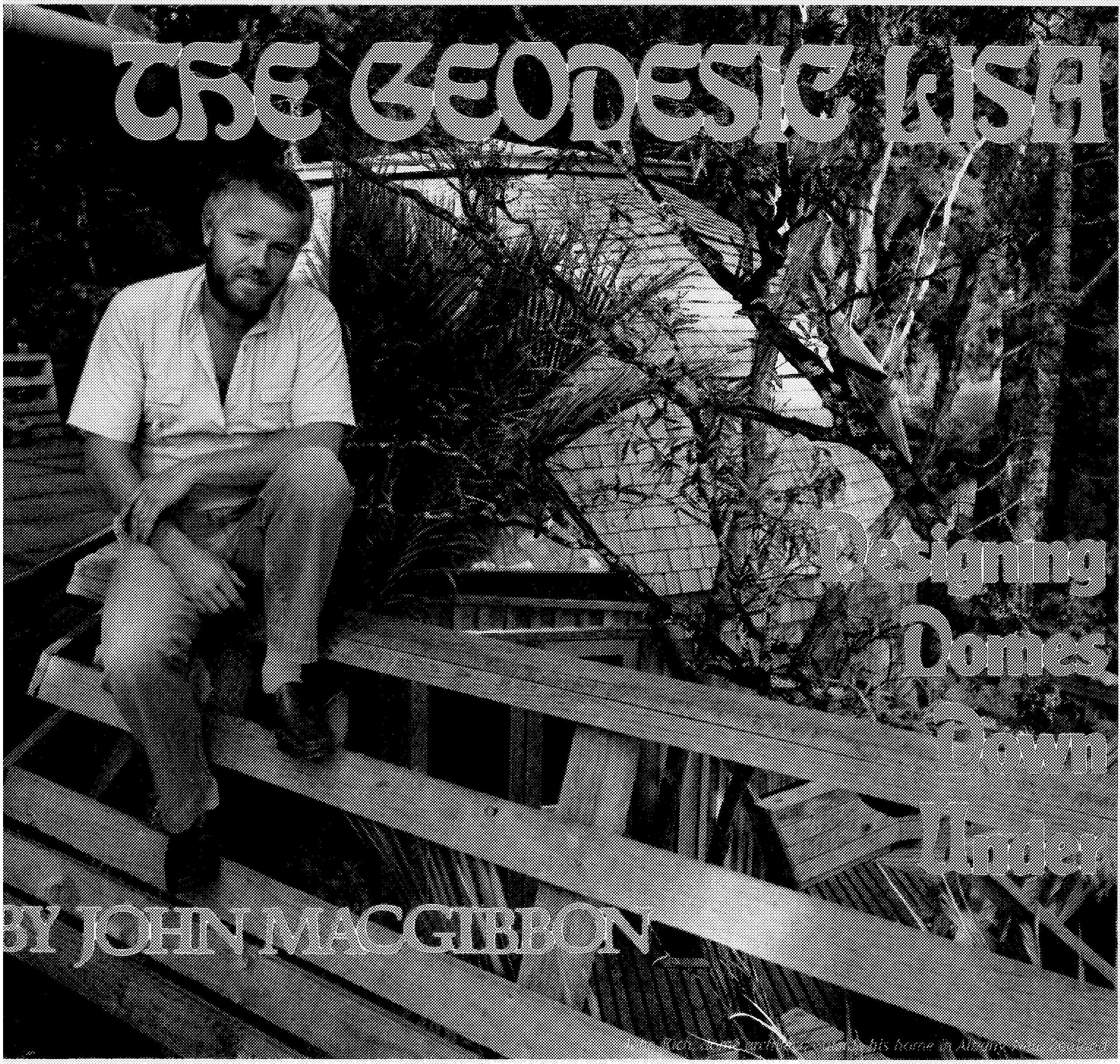
THE GEODESIC LISA

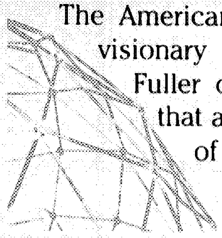
Designing Domes Down Under

BY JOHN MACGIBBON



Photos by Jennie Beatty

John Rich, dome architect, outside his home in Albany, New Zealand



The American architect and visionary R. Buckminster Fuller once postulated that a geodesic dome of huge diameter would act like a balloon.

In the early 1970s John Rich, a young man in Auckland, New Zealand, decided to check the theory out. He reckoned that with today's technology it would be possible to build a metal sphere two kilometers in diameter. One hundred levels could be built inside the sphere, providing enough space for one hundred thousand people. Each person would have fifty square meters of personal space, yet there would still be room for golf courses, equestrian parks, and artificial lakes.

Rich estimated the total weight of the sphere, then calculated the total weight of air that would be displaced by a one degree centigrade rise in air temperature. He discovered that, yes, the whole sphere would float away like a balloon.

At the time Rich was an engineer who had dabbled in geodesic dome design and had built a few models. Today the dabbling has become a career, and he has become New Zealand's foremost designer and builder of geodesic domes.

Rich says his structure is low-tech—but that is true only at the building stage. His design work is definitely high-tech; it's done on an Apple Lisa microcomputer, using *LisaDraw* and *LisaCalc*.

Dome on the Range

This fascination with geodesics began in 1969 when Rich, then a student, was shown a model dome by a friend blessed with the unlikely name of Wendy the Moustache. Rich wasn't particularly impressed.

Later, when New Zealand celebrated sixties counterculture with its own version of the *Whole Earth Catalog*, Rich read how to construct a geodesic dome using plastic drinking straws. He tried, became hooked, and today, more than two hundred models and full-size structures later, he's still churning 'em out.

Rich built his first dome "of any size" nine years ago; it followed a dozen or so domes of greenhouse dimension. His real career watershed came in 1980, when Rich designed and built New Zealand's first large permanent dome. This was an eighty-foot-diameter packing shed and fruit sales center in the shape of an ellipsoidal icosahedron.

The following year Rich got into domes full-time, and he now provides a comprehensive design and building service.

With his trusty assistant, the Lisa, Rich offers geometry programs and structural analysis of geodesics for domes of any shape, frequency, form, or size. He will use any material, though his preference is for lumber and plywood. This is not surprising, given the abundance of wood in tree-rich New Zealand.

Rich lives on an eleven-acre block near the small village of Albany, twelve miles north of Auckland, New Zealand's largest city.

The steep block, heavily wooded with native bush and tree ferns, is also home for his wife Michelle, children Christopher, Daniel, and Benjamin, and an assortment of animals.

Other than in their choice of dwelling, the Riches are fairly typical settlers. Most of the district has been subdivided into ten-acre farmlets by people who have escaped city life. Auckland may not be large by American standards, but with a population of nearly one million it represents big smoke and fast living in this small South Pacific land.

Unlike most of their neighbors, the Riches are not urban refugees. They came from a kiwi fruit orchard 230 miles away at Opotiki in the Bay of Plenty. Moving to Albany meant reunification for the family, because Rich had previously divided his time between work at the plywood factory in Auckland and commuting home on the weekends.

Inside a Dome Home

Rich's approach to geodesics is practical more than mystical. His own home combines a dome with a more conventional pole home construction. The materials—poles, framing, plywood, and shingles—are pinus radiata, the most common exotic timber species in New Zealand. Originally imported from California, the species is the basis for an important and growing timber industry. Pines grow faster in New Zealand's moist and temperate climate than anywhere else on earth.

The twenty-six-foot-wide dome portion of the house includes the lounge, plus a mezzanine library level. The dome interior is attractively paneled with native kauri timbers. Triangular windows at varying angles lend interesting slants to the outside world of clouds, trees, and ferns.

Furnishings are simple, with an emphasis on natural materials: a lovely old out-of-tune piano, a couple of sideboards, some whatnots containing family heirlooms, a lounge suite, and an old stuffed sofa.

Plus a stereo. Domes make magnificent music.

Leaks, often a problem in geodesic domes, have not occurred. The weatherproofing, consisting of the pine shingles plus butyl rubber, has been effective. Butyl also forms a lining for gutters, which are built from plywood.

Service areas of the house such as kitchen, laundry, and bathrooms are in the "conventional" structure, as are bedrooms and Rich's study. Not being a purist, he will admit that circular domes don't suit all purposes. For instance, house fittings such as baths, showers, benches, and tubs come in rectangular shapes. Nonrectangular fittings in New Zealand have to be custom-built and thus are expensive.

The home's immediate environs are all raised above the ground: wooden decking supported by poles. Plants in terra-cotta pots substitute for flower gardens, while trees just come naturally—the house nestles among an impressive stand of tall, clean-limbed kauris.

Days of Domes Down Under

Rich admits that his domes are less sophisticated than some of the large American structures, which have even borrowed techniques from Boeing and NASA.

"Here in New Zealand, with a small market and a lower level of technological development, we've needed a different approach to geodesics," he says.

"We must look at what technology is available and develop building systems to suit it. We're about halfway between the mud hut and the space shuttle *Columbia*."

While he admires the technology in kitset packages marketed by U.S. companies such as Monterey Domes and Cathedralite Domes, he points out that New Zealand doesn't have the market to justify volume production of such material.

"We just have to cook with what's in the larder," says this antipodean dome builder.

The main point is that his houses work, look good, and are relatively cheap. And in terms of domestic dome housing design, he reckons he could teach Americans a thing or two. Rich believes he is about five or six years ahead in some areas.

Occasionally he does have daydreams beyond budgetary considerations. One such dream is to build a dome as a skybreak over most of a section of land in which hedges and gardens would be used as internal partitions. There would be several levels, some made up of lawns, others composed of brick patios, and still others containing timber decks. A garden would hang from the internal surface of the dome, and the design would include solar heating.

But realistically Rich considers small domes of 575–850 square feet with a mezzanine level over 60 to 75 percent of the interior to be the most economical for an average-size house. Additional space can be provided in simple rectangular projections from the dome.

"Stay as simple as you can—domes don't need to be large in order to feel large," he says.

Building costs end up about the same as for conventional houses, even though a geodesic dome has only 25 percent of the framing timber. The surface area is about 60 to 70 percent that of a conventional house.

But you can get away with cheaper materials in conventional houses, and fittings such as doors and windows can be bought off the shelf. Not so with a dome house.

"To seal a dome adequately you've got to use quality products like asphalt or timber shingles, as well as butynol. You're putting your savings back in quality, so you end up with a better house," Rich explains.

You also get a very strong house, an important consideration in this earthquake-prone country. Geodesic structures are immensely strong in relation to their mass.

"Geodesics are the way the universe is held together," Rich explains. "Like the moon spinning around the earth and the earth spinning around the sun—it's a question of a balance of forces. And these forces tend to be triangulated and hold things stable."

Other advantages enjoyed by domes include lower insulation cost, and lower ongoing energy costs for heating and air conditioning.

Rich has now designed and built twenty-seven sizable domes. They range from a small egg-shaped dome for a Buddhist community to his current project, a 200-seat theater restaurant at Whangarei, in the far north of New Zealand.

A unique aspect of his business is the extent to which he is able to change the geodesic form to suit the requirements of customers. For that ability he has the Lisa to thank.

Dome Design for the Daring

One of the unavoidable high costs in dome architecture is the design work. More thought has to go into dome design than into a conventional house.

Domes may look simple, but their geometry can be extremely complex, particularly if customers want something more than a very straightforward design.

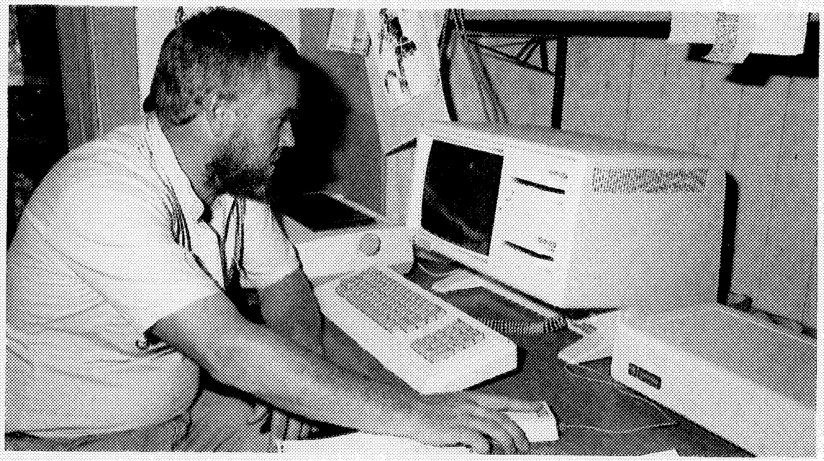
For instance, the "standard" spheroid, three-frequency icosahedron dome is impractical if the diameter exceeds thirty-three feet. It becomes very tall and needs to be squashed down a little. This is harder than it sounds and requires a considerable amount of complicated recalculation.

A spheroid form requires only two different panel sizes and three connector variations. Moving to a three-frequency ellipsoidal dome requires twelve-panel variations and eight connectors. A quantum jump in complexity comes with the four-frequency super-ellipsoidal dome, which requires eighty-five panel variations and fifty-three hub connector variations.

With *LisaCalc*, changes can readily be made if a client changes her mind about the size and shape of the dome. Variables can just be fed into the specification master, and, presto, there's your new dome.

"Now I can take a dome and rotate it to whatever node I want at the top, and then squash it, stretch it, or even turn it into a super-ellipsoidal shape like a television," Rich explains.

"Lisa will then print out the XYZ (Carte-



Lisa helps Rich do calculations he couldn't do on his Apple II.

sian) coordinates.

"I've also used *LisaCalc* to invent my own free-flow, amorphous shapes that follow no regular geometry. To draw them I use the graphics package to print out the coordinates, then swop them across to *LisaDraw*, draw it up, and then turn it around."

Still, his most complex dome was designed on a Casio FX-80 scientific calculator. It was a four-frequency super-ellipsoidal icosahedron recently designed and built for the Plywood Association of New Zealand. Nearly rectangular, it had only just enough curvature to qualify as a dome.

Designing that dome took forty-two hours of calculation. It could be done today with *LisaCalc* in about three minutes.

"The beauty of Lisa is that you don't need any training; with *LisaCalc*, if you have basic algebra as one of your skills, you can do it," Rich explains.

He estimates that the computer saves him one extra wage bill, and he anticipates more savings when Apple releases a drawing package for its color plotter. Structural analysis is another application he's looking forward to using.

Before buying the Lisa, Rich tried an Apple II and *VisiCalc*. He quickly gave it up.

"I was overloading it at one frequency, which was a basic icosahedron. As soon as I tried to break the basic triangle down into smaller triangles the Apple II was completely and utterly hopeless. I looked at boosting the memory, but it still wasn't going to get anywhere near what I wanted."

So it was simply a case of *Move over Apple II, make way for one megabyte of Apple Lisa.* Though Rich has never regretted the move, it was a different matter for his kids, who had enjoyed the Apple as a games machine.

"We tried, unsuccessfully, to set up a system with the Apple II where the kids could play games only if they did something educational first," says Rich. Now, fobbed off with a substitute Sinclair ZX81, the children are less convinced about the Lisa than their dad.

Even Lisa itself cannot always cope with dome geometry. Rich has "hung" the system five times trying to do calculations that are too big.

Beyond design work, the system is paying its way handsomely in business administration. Standard functions like word processing, invoicing, debtors and creditors, stock, wages, and wages analyses are obvious and very welcome benefits.

However, much of Rich's admiration is reserved for a program he never thought he would have much use for: *LisaList*, a simple unstructured database.

"*LisaList* is just amazing," Rich says. "Now we use it to keep all our diary records, all our phone calls—everything gets entered into the database at some point. And we can easily unscramble the list and print out data relating to, say, a particular client, or a particular day."

But no one is ever satisfied. In fact, Rich has a few suggestions for Apple Inc.

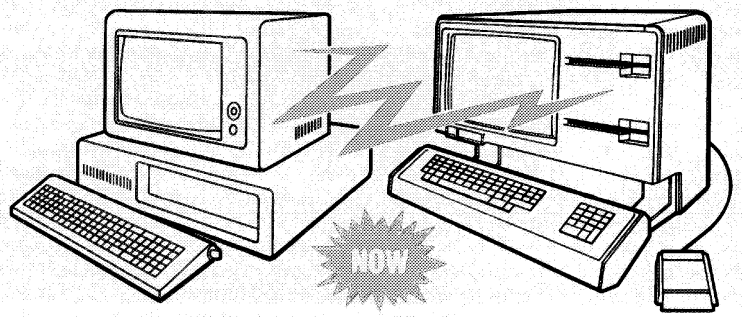
For instance, why not include four-function mathematical capability in *LisaList*? Why can't you stack up the "look-up" and "search" functions in *LisaCalc*? Couldn't moving between packages be made easier?

Rich's Lisa didn't come cheap: NZ$26,450 to be exact. And he was furious when, less than two months later, a combination of lower pricing by Apple and a reduction in government sales tax brought the price down to less than NZ$18,000.

Even this figure would have U.S. buyers shuddering! Nevertheless Rich is more than happy with his investment. He'll stick with Lisa, but....

"Lisa will be made redundant by the one I can talk to," he says. "I'll be able to drive along in my car and say to my computer, 'What's the latest situation with the cash flow?' And it'll say, 'You can retire in seven days' time.'

"That will be my choice of computer."



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